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of the animals found, and the considerable additions to geological knowledge of the region of the central lakes, to which his colleague, Mr. Fergusson, especially contributed.

The Scope of Geographic Investigation in Lakes (Die Aufgabe Geographischer Forschung an Seen). By Prof. Dr. Willi Ule, Privatdocent in the University of Halle.*

Limnology, the science of lakes, starting as a branch of geography, has of late developed into an independent science, drawing upon quite a number of sciences. It is time to define the principles according to which its problems are to be included in or excluded from geography.

Forel's classification of limnology exceeds the geographic scope, since he divides it into hydrography, geology, petrography, hydrology, climatology, chemistry, thermics, optics, and biology. Ule, laying stress on the geographic point of view, makes the following classifications:

1. General geographic conditions.
2. Morphology and geology of lakes.
3. Physical conditions of the water.
4. Chemical composition of the water and of its deposits.
5. Biologic conditions.
6. Anthropogeographic significance of lakes.

To illustrate the distinction, he observes that the investigation of the thermic conditions is mainly a physical or limnologic problem, while the explanation of the differences in temperature among lakes is mainly the task of the geographer. He proceeds to enumerate the geographic problems under each of the six headings of his classification.

1. (*a*) First among *general geographic conditions* is the description of the location, shape, and size of lakes. These suggest classifications (lakes of coasts, river lowlands, folded areas, fractured areas, volcanic, glacial, and drainless regions). (*b*) Description of the tributary basin, including supply and drainage, and involving a discussion of the climatology. (*c*) Budget of the lake, that is, relation between inflow and outflow. (*d*) Height of water, including oscillations, which, by comparison with record of precipitation, show whether the lake is fed mainly by surface water or by ground

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* From Abhandlungen der K. K. Geographischen Gesellschaft in Wien, IV Band, 1902, No. 6. Wien, 1902.

water. (*e*) The mode of feeding suggests a new classification (rain-fed, groundwater-fed, spring-fed, river-fed, glacier-fed). (*f*) Influence of lakes on climate, which may throw light on anthropogeographic and phytogeographic problems. The freezing of lakes is a geographic problem, because dependent on location, and because its duration influences human conditions. The cause of freezing and its physical mechanism, on the other hand, belong to the province of the limnologist.

2. (*a*) First among problems of *morphology and geology* is the comparison of the shape of the lake basin with the surrounding orography. Was the lake created by the same process as the rest of the land surface, or subsequently? Different classes of land are wont to be characterized by different types of lake basins. Thus, in the arid regions, lakes, as a rule, are quite shallow; if deep lakes occur there, they are of different origin. (*b*) The shape of the lake basin is determined by its mode of origin. A trough-like form indicates glacial origin. Dammed river valleys show the marks of running water. (*c*) From soundings the mean depth and the relation of this and of the greatest depth to the area of the lake may be calculated. (*d*) Influence of the geologic age and structure of the country rock. (*e*) Influence of recent processes, such as changes in shores and fillings of the basin, often suggesting explanations of earlier processes. The transformation of the shores is the effect of wave-beat, wind and rain. Do these work in the same or in opposite directions? Do they vary with the height of water? The filling with sediment is partly eolian and partly river-borne—the former prevailing in arid, the latter in humid countries. Annual measurements of deposits show rate of filling. Delta formation is governed by mud-carrying capacity of rivers and by oscillations of lake level. From volume of deposits and rate of deposition the age of some alpine lakes, beginning with the close of the glacial period, has been calculated at 16,000 to 32,000 years. (*f*) Morphologic and geologic conditions often serve to explain the origin of the lake. This is eminently a geographic problem, since many types of lakes are confined to certain strongly-marked geographic provinces. (*g*) The mode of origin suggests another classification. Ule makes the division into primary and secondary lakes, each being subdivided according to the nature of the lake-creating forces.

3. As regards the *physical conditions of the water*, it is more difficult to define the province of geography. The physical conditions are static and dynamic, thermic, optic, and acoustic.

STATICS AND DYNAMICS.—Certain deformations of lake level may be due to attraction by land masses. The phenomenon of *seiches* has been observed in nearly all large lakes. Is it influenced by geographic location or climate or by the condition of the atmosphere? The wave-beat determines the action on the shore and influences navigation. Currents have been observed in some lakes.

THERMICS.—Hardly any two lakes show the same temperature record. It is the geographer's task to study the variations by comparison with geographic location. Sometimes thermic peculiarities are due solely to local surroundings. The relations between water temperature and air temperature, and between temperature and evaporation, furnish subjects of inquiry.

OPTICS.—Many lakes, geographically alike, show the same colour, though considerably different in physical constitution. The North German lakes, as a rule, are less transparent than the Alpine lakes. Is this due to different geographic conditions?

ACOUSTICS.—The so-called air-puffs, peculiar detonations heard at the seashore and on lakeshores, can only be explained when their geographic distribution shall have been ascertained.

4. As regards the *chemical composition*, the geographer is called upon to study it with reference to the surroundings. Artificial colouring enables the course of subterranean water to be traced. What becomes of the substances, in suspension or solution, contributed by rivers? Is their transformation dependent on geographic conditions? Passarge found that a large part of the meadow-lime deposits originated from vegetal mud in lakes subsequently filled. Comparison of results from different lakes would show any existing influence of geographic factors.

5. The importance of *biologic conditions* is illustrated by Samter's discovery, in Madü lake, of marine crustaceans that are to be regarded as relicts of the glacial period. To what extent can marine animals adapt themselves to fresh water? While the limnologist investigates the organic world of lakes, the geographer has to inquire into its origin and its significance for the lake phenomenon. At times the flora or fauna may furnish hints as to the age of a lake.

6. The *anthropogeographic significance* of lakes is evident. They furnish drink and food, and are often surrounded by fertile lowlands, thus inviting settlement. They are, probably, favoured as regards climate. They interrupt commerce by land, aid it by navigation, attract it by the settlements along their shores. Where they

freeze in winter, travel is transformed. They are apt to serve as gathering-points for the commerce of the tributary valleys. They furnish power. Finally, they are regulators of outflow, dominating the valleys below.

Prof. Ule's paper must be regarded as a suggestive contribution to the irksome but unavoidable task of drawing sharp lines where none exist in nature. If we define geography simply as the science of the earth, it manifestly embraces all the sciences, including law and theology. If we exclude from it everything that belongs to another science, there will be no geography left. Hence, if we are to have a science of geography, we must add to the generic term "science of the earth" some specific point of view from which the earth is regarded. Ritter's definition of geography as "the science of the relation between earth and man" seems to be most in favour. Ule, in his closing remarks, defines the scope of modern geography to be "the investigation of the reciprocal effects of the several phenomena of a country, and their causal connection." It may be questioned whether either definition will enable us in any particular case to say: This belongs to geography; or, This does not belong to geography. However, since this specialization is the order of the day, there is no doubt that in the future the debatable ground between geography and other sciences will bear an ever-lessening proportion to the well-recognized field covered by the definition of geography, whatever that definition may eventually be. The present work is clearly a step in that direction. R. S.

Unknown Mexico. A Record of Five Years' Exploration among the Tribes of the Western Sierra Madre; in the Tierra Caliente of Tepic and Jalisco; and among the Tarascos of Michoacan. By Carl Lumholtz, M.A., Member of the Society of Sciences of Norway; Associé Étranger de la Société d'Anthropologie de Paris; Author of "Among Cannibals," etc. Illustrated. New York, Charles Scribner's Sons, 1902. 2 vols. 8vo.

Mr. Lumholtz describes in these volumes the results of four journeys in the Western Sierra Madre—the first in 1890–91, the second in 1892–93, the third in 1894–97, and the fourth in 1898, with Dr. A. Hrdlicka.

It was a happy inspiration that led him to seek among the tribes inhabiting this great range the beliefs and manners and practices which have survived the Conquest, and the ethnologist will be